European Gravity Service for Improved Emergency Management

a new Horizon2020 project to serve the international community and improve the accessibility to gravity field products

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GRACE Science Team Meeting

September 29 – October 1, 2014

Potsdam, Germany

Introduction

A proposal for the project

EGSIEM European Gravity Service for Improved Emergency Management

has been submitted this spring to the EO-1 Space Call of the Horizon 2020 Framework Program for Research and Innovation.

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
JOINT RESEARCH CENTRE
Directorate H - Institute for Environment and Sustainability
Climate Risk Management

EGSIEM project overview (1)

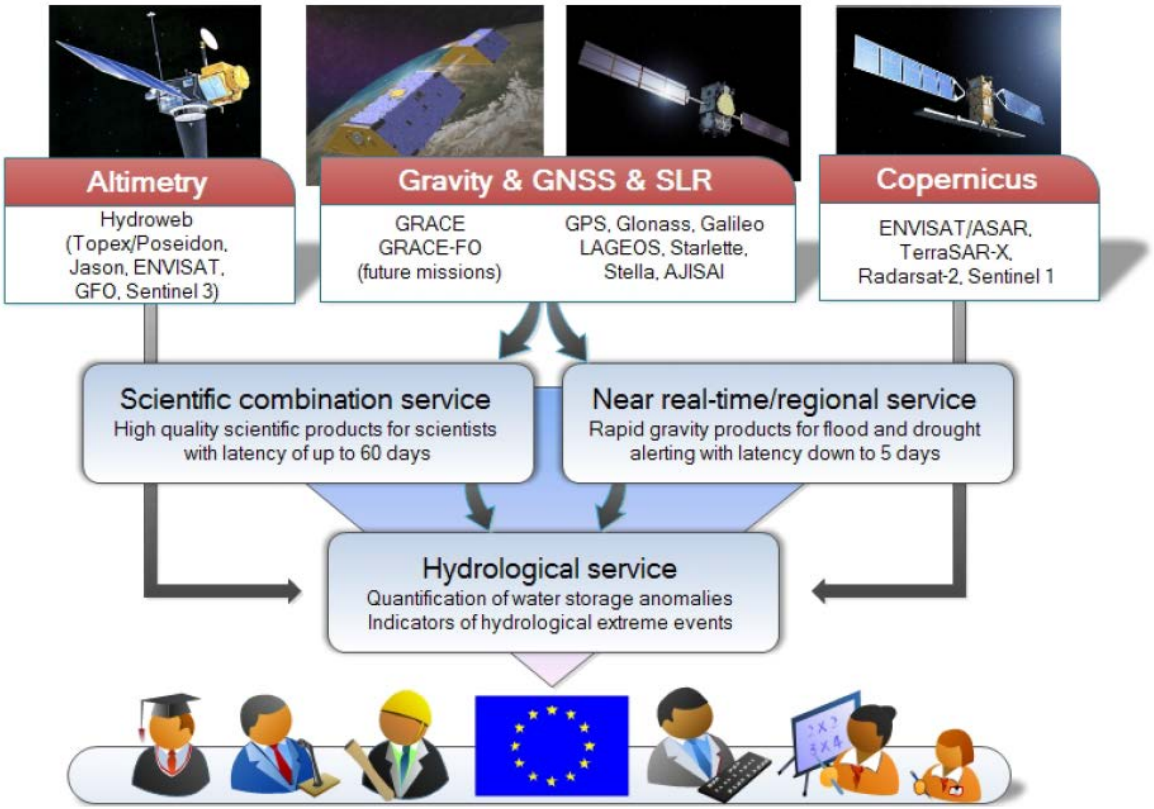
Currently EGSIEM is in the process of Grant Preparation with the European Commission. The project start is scheduled for January 1, 2015.

The three main objectives of EGSIEM are to

- **deliver the best gravity products for applications in Earth and environmental science research**
- **reduce the latency and increase the temporal resolution of the gravity and therefore mass redistribution products**
- **develop gravity-based indicators for extreme hydrological events and demonstrate their value for flood and drought forecasting and monitoring services**

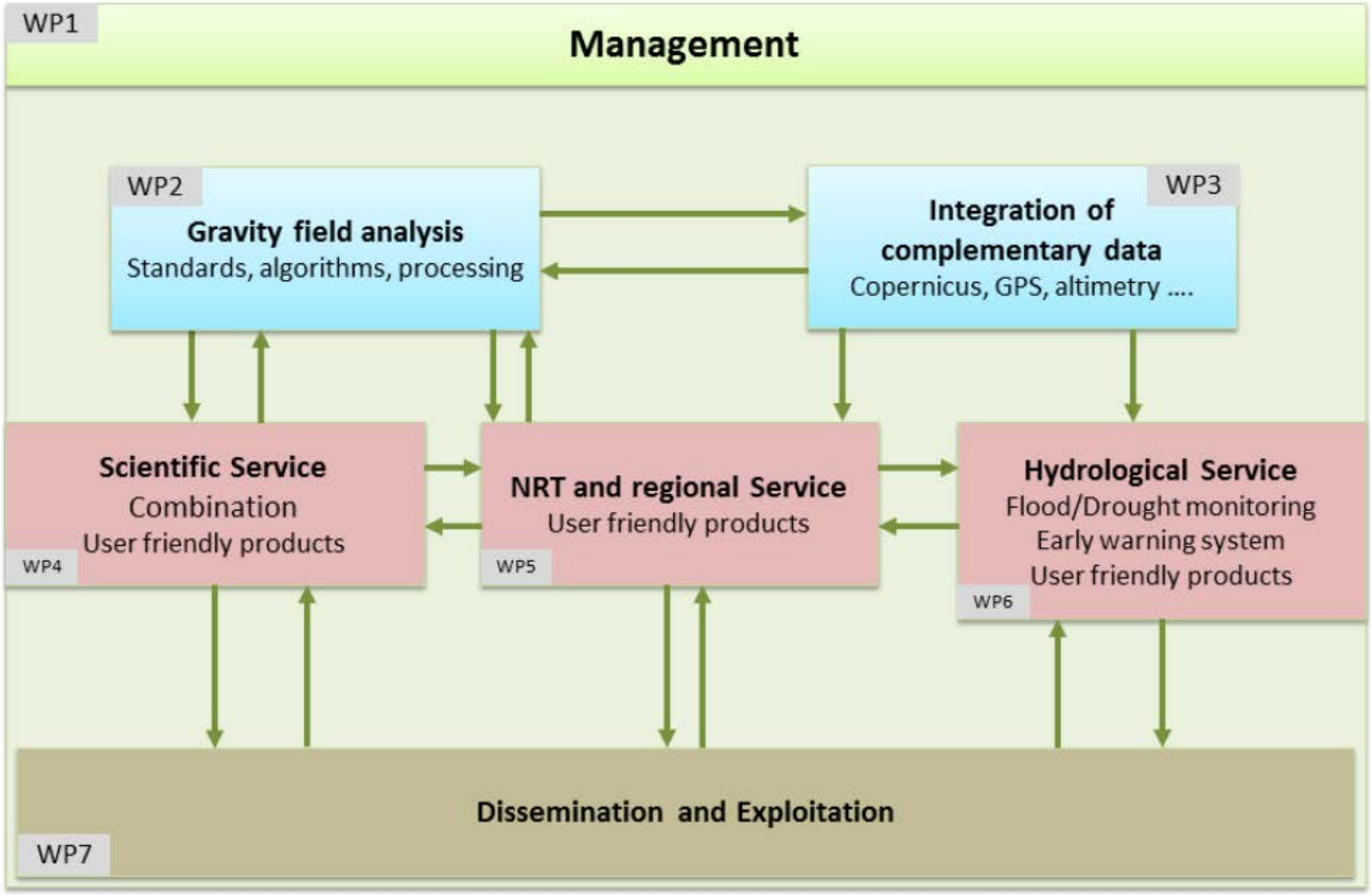
EGSIEM project overview (2)

- **Three dedicated services shall be established**



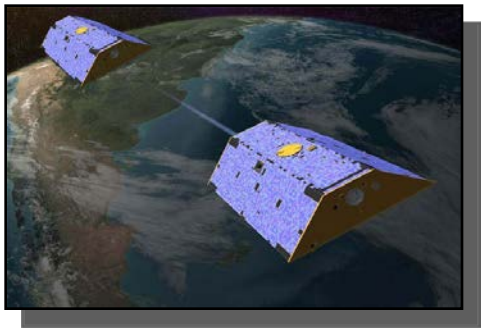
Services will be tailored to the needs of governments, scientists, decision makers, stakeholders and engineers. Special visualisation tools will be used to inform, update, and attract also the large public.

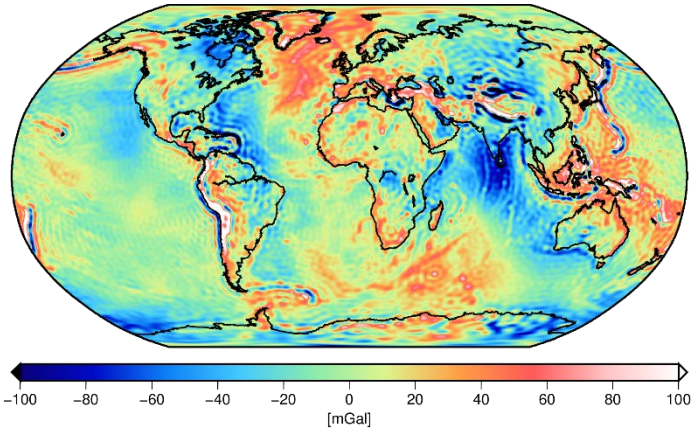
EGSIEM project overview (3)



The used input data sources and the anticipated services that shall be established are reflected in the EGSIEM WP structure.

WP2: Gravity Field Analysis





Improved gravity field solutions by:

- Harmonization of processing standards
- Improvements of analysis methods
- Error analysis with End-to-End simulator

EGSIEM Analysis Centers (ACs):

- **GFZ** (Direct Approach)
- **CNES** (Direct Approach)
- **AIUB** (Celestial Mechanics Approach)
- **ITSG** (Short-Arc Approach)
- **University of Luxembourg** (Acc. Approach)
- **More in the future …**

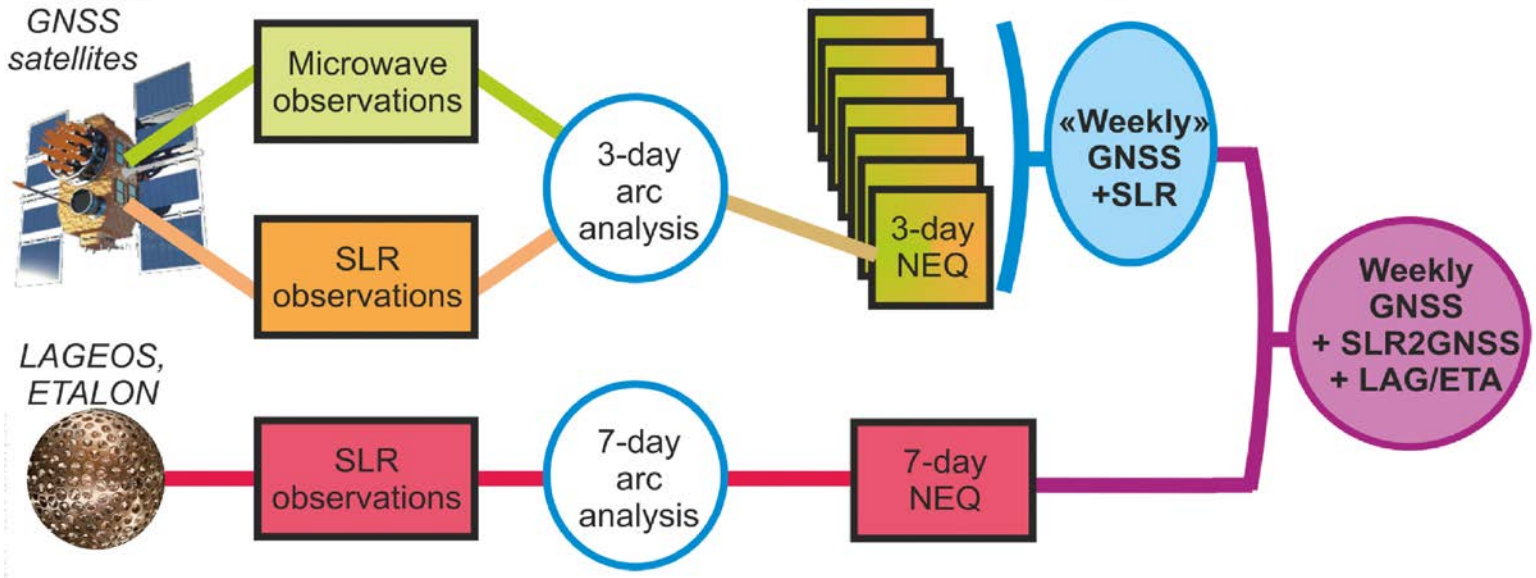
=> Provide different solutions for the combination in WP 4

WP3: Integration of complementary data (1)

Data	Application
GNSS	Reference frame
SLR	Reference frame + gravity
GNSS loading	Validation
Ocean bottom pressure	
Altimetry data (lake and river levels)	Integration into hydrological service (and validation)
GIA models	Separation of GIA-related trend from hydrological trend (where necessary)
Historical flood situations	Validation of GRACE derived flood and drought indices

WP3: Integration of complementary data (2)

- **Consistent reference frame for all products**
- **Linking geometry (GNSS) and gravity (SLR)**
- **Degree 1 coefficients from SLR directly incorporated**
- **NRT service requires NRT reference frame**



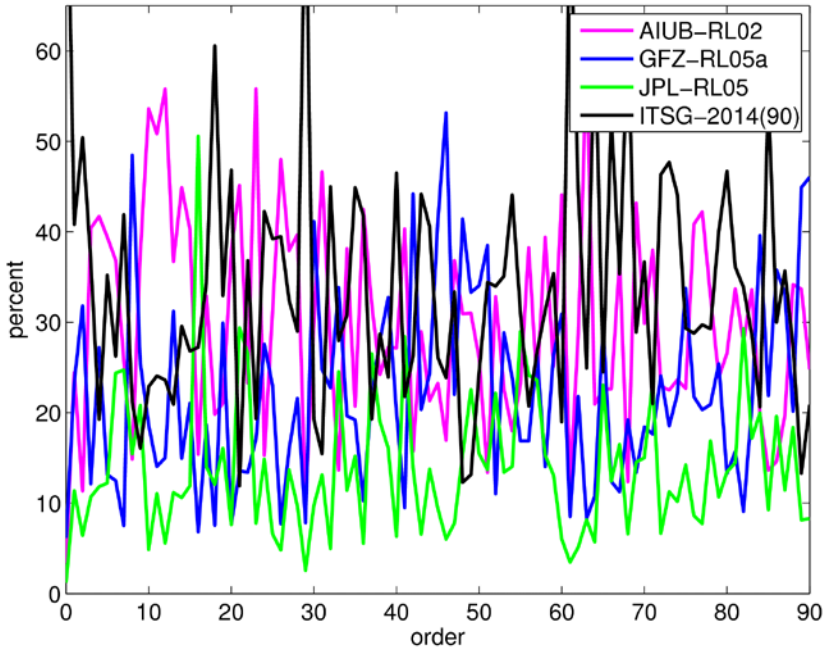
WP4: Scientific Service (1)

Adopting rigorous and independent processing approaches, each AC will deliver consistent gravity field solutions. For the first time, a meaningful combination by the Analysis Center Coordinator (ACC) will be possible. This task will be coordinated by AIUB, it includes

- **Comparison of the AC solutions, identification of gross errors**
- **Pair-wise comparison of gravity solutions to approximate empirical weights for the individual ACs**
- **Combination of all AC solutions to generate combined solutions using the following two schemes:**
  - **Calculate weighted averages based on the empirical weights**
  - **Determine the combined solution based on a combination of normal equations (NEQ) generated by the individual ACs**
- **Provide suitable products for hydrological and geophysical applications from the combined and individual AC products**

Monthly relative weights (example 03/2008)

Contribution per order



Mean:

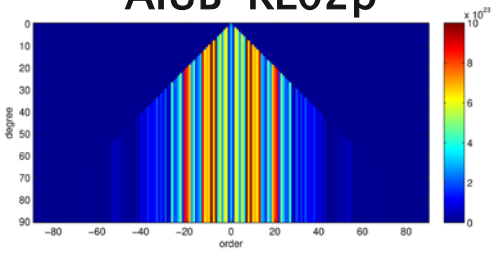
AIUB: 30 %

GFZ: 22 %

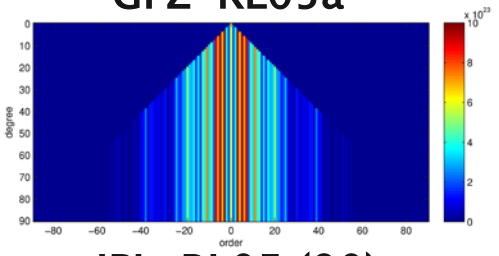
JPL: 14 %

ITSG: 34 %

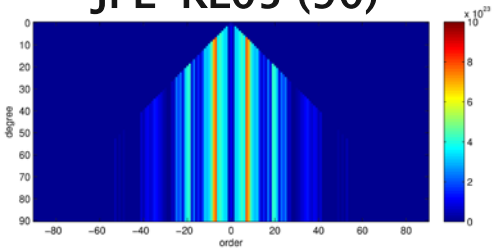
AIUB-RL02p



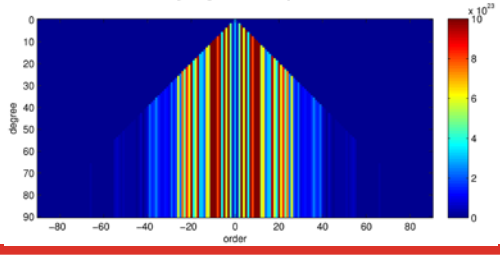
GFZ-RL05a



JPL-RL05 (90)



ITSG-2014



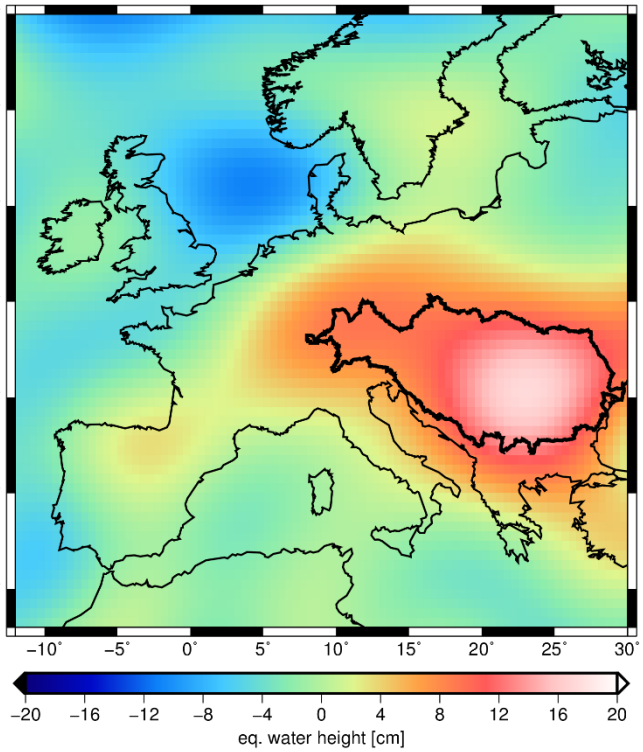
Percent: $100\% * w_i/(w_1+w_2+w_3)$

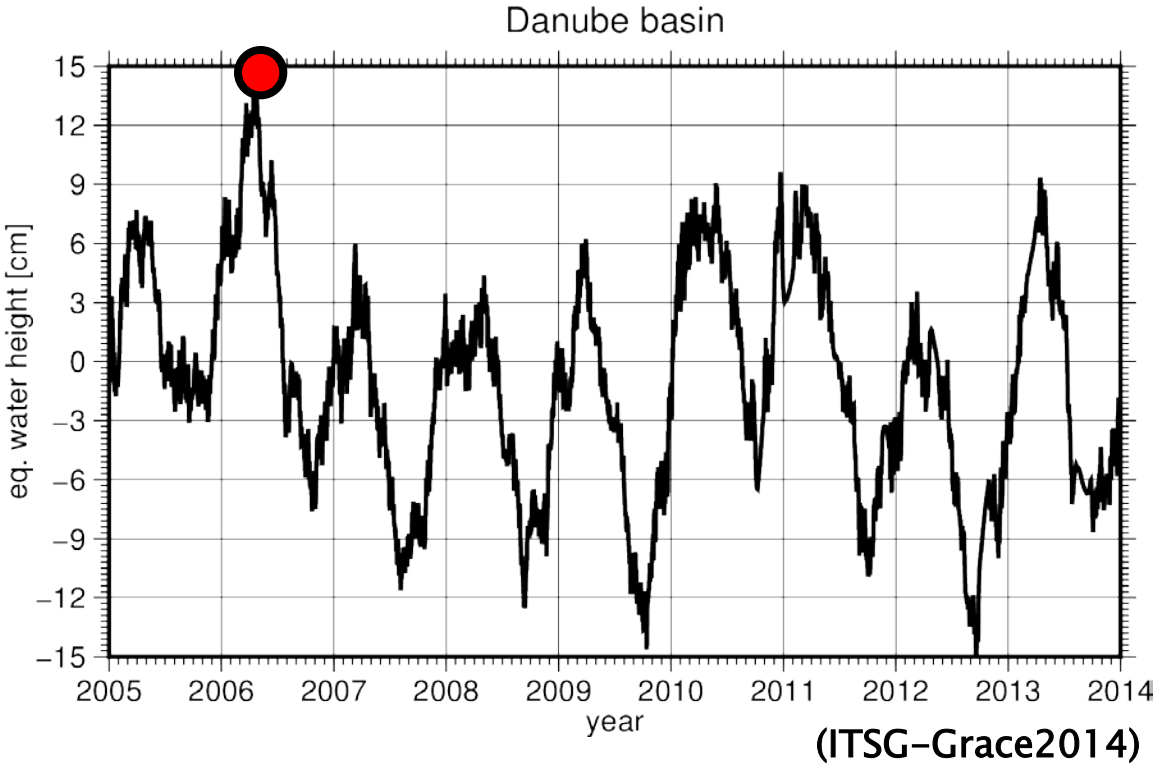
Weight matrix: $1/RMS^2$ per order

WP5: Near real-time and regional service

Daily updated solution (Near real-time with max. 5 days delay)

- **ITSG: Kalman filtered solutions**
- **GFZ: Alternative representations (e.g., radial basis functions)**

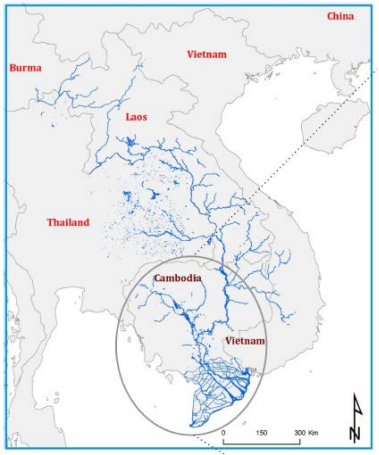


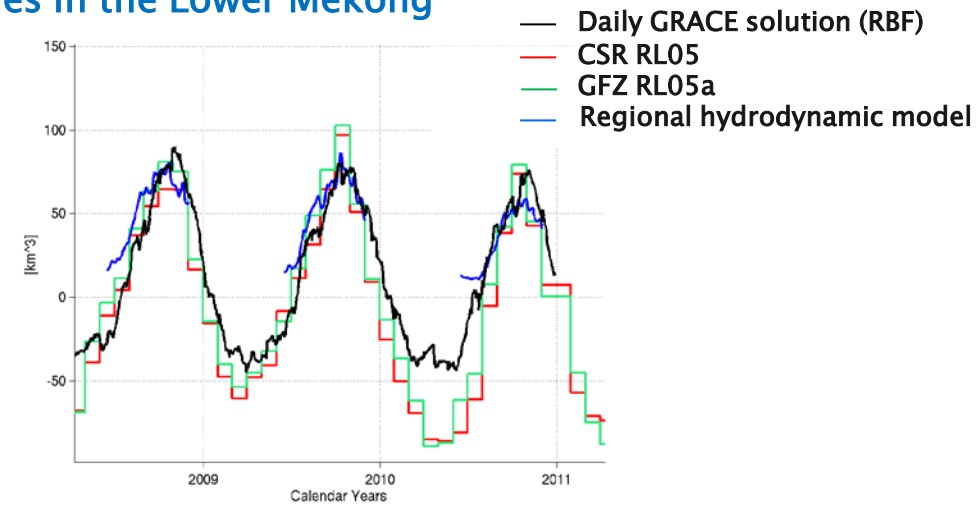


WP6: Hyrdological Service (1)

- **Gravity-based flood and drought indicators as descriptors of the integral wetness status of river basins**
  → early warning for hydrological extreme events

Flood volumes in the Lower Mekong





- **Testing the added value of gravity-based indicators at different lead times (several months to near real time)**

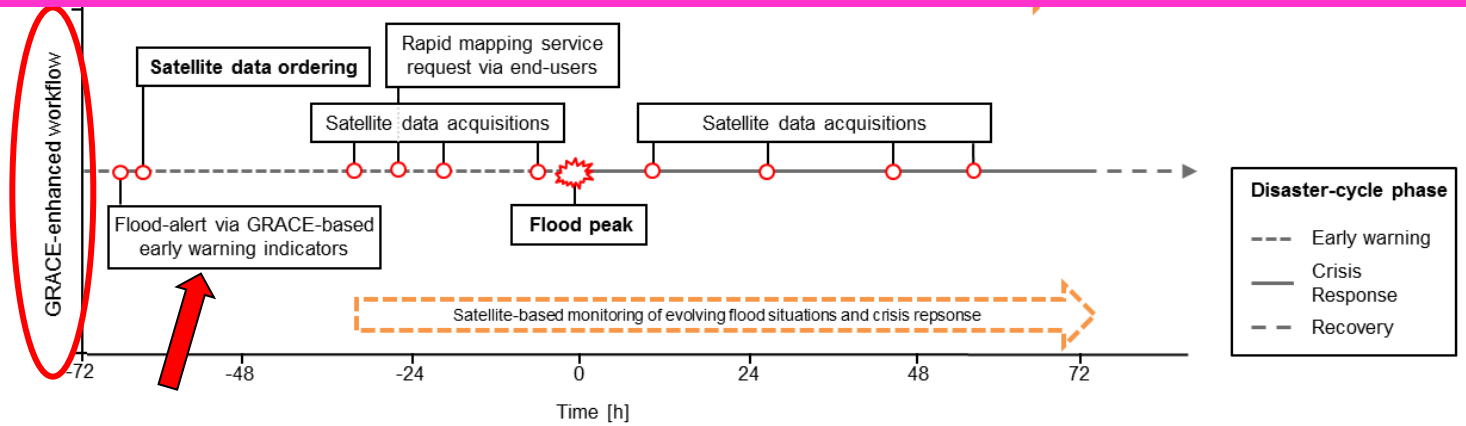
  - via assimilation into flood forecasting models

  - in statistical forecasting approaches

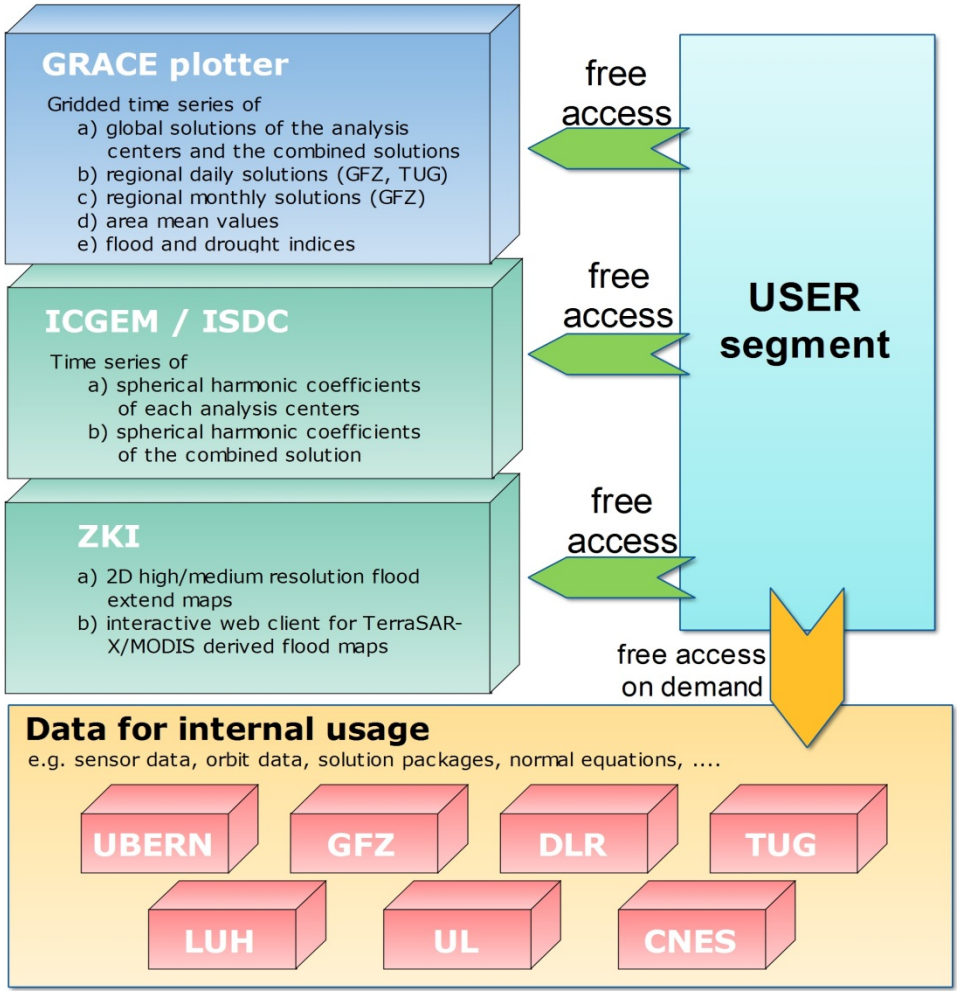
WP6: Hyrdological Service (2)

- **Improved rapid mapping by on-demand programming of satellite acquisitions**
- **Integration into automatic flood emergency management services**

- **The performance of the NRT service will be tested using historical hydrological extreme events.**
- **An operational test run of half a year is foreseen in the frame of DLR's Center for Satellite Based Crisis Information.**



WP7: Dissemination and Exploitation (1)



EGSIEM will have an open data policy with respect to all data generated within the project. Accessibility to all levels will be guaranteed via the project website.

A central component of the EGSIEM dissemination activities will be the GRACE plotter, which allows easy data access and visualization.

WP7: Dissemination and Exploitation (2)

géode&cie

EGSIEM Visualization Tool: Extension of The GRACE Plotter, developped by Géode & Cie for CNES.

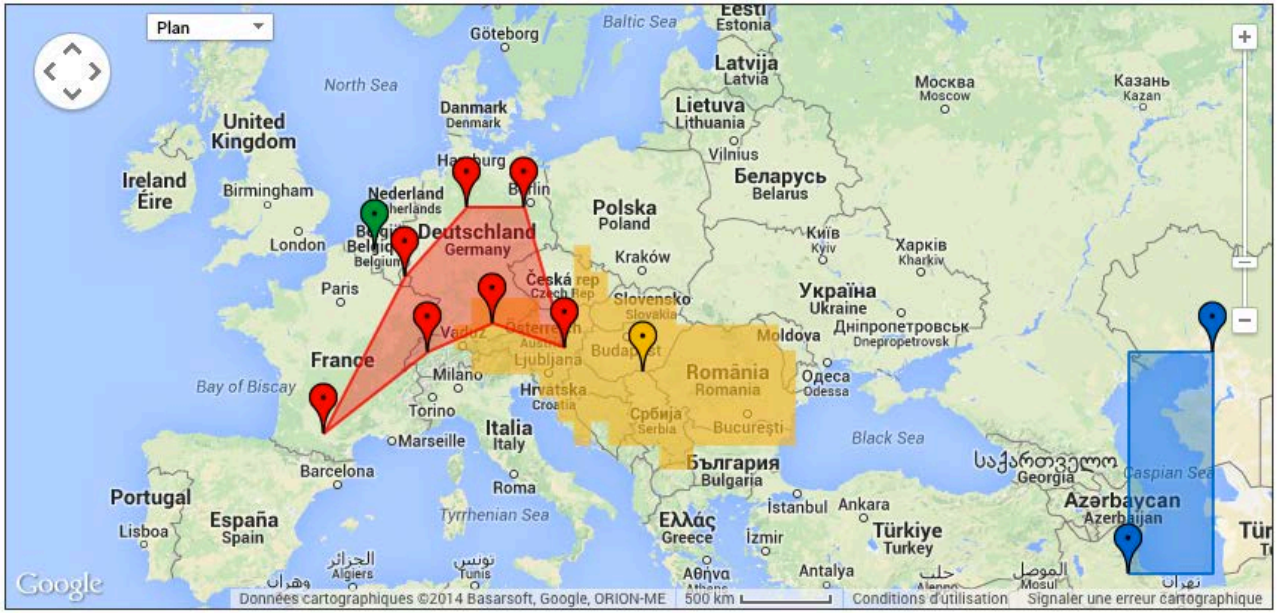
Data selection

center, type, version…

Multiple possibilities for extraction areas, custom or predefined

Interactive plots

Series title	Data center	Version	Area	Address	Latitude	Longitude	Apply
Series 1	CNES/GRGS	RL03-v1	7-Heptagon	Bern, Switzerland	46.947922	7.444608	All
				Oberpfaffenhofen, Germa	48.074400	11.262200	
				Graz, Austria	47.070714	15.439504	
				Potsdam, Germany	52.390569	13.064473	
				Hannover, Germany	52.375892	9.732010	
				Luxembourg	49.815273	6.129583	
				Toulouse, France	43.604652	1.444209	
Series 2	GFZ	RL05-DDK5	Point	Brussels, European Comm	50.842317	4.370471	All
Series 3	CSR	RL05-DDK5	Danube	Danube basin	46.121053	19.994737	All
Series 4	JPL	RL05-DDK5	Rectangle	Iran, Province d'Ardabil	37.385404	48.373454	All
				Kazakhstan, District de Jy	46.937235	53.227348	



WP7: Dissemination and Exploitation (3)

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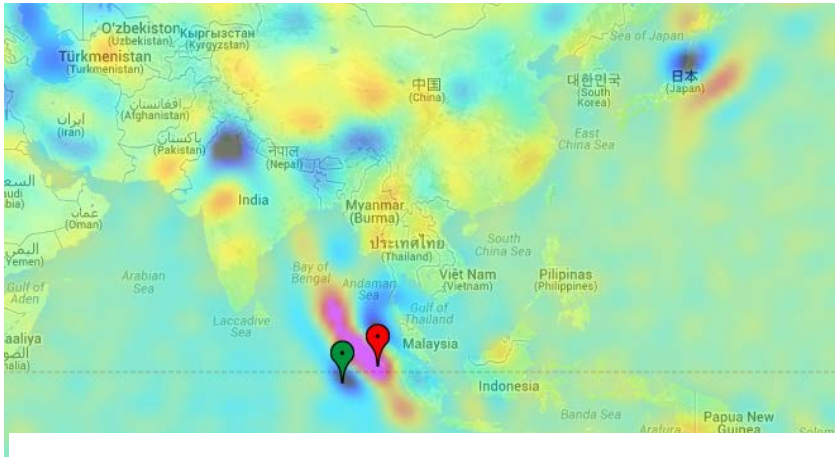
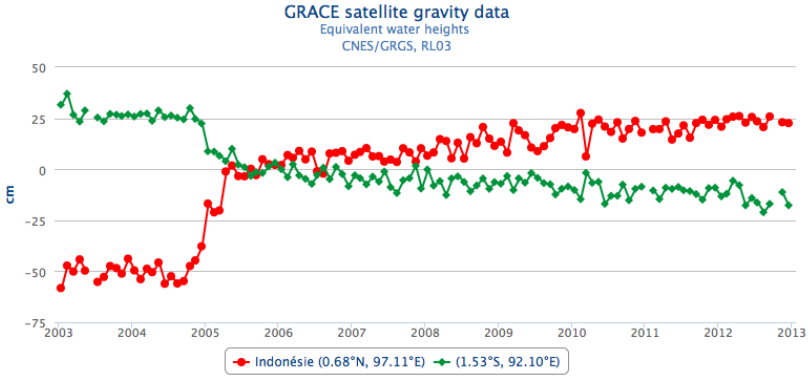
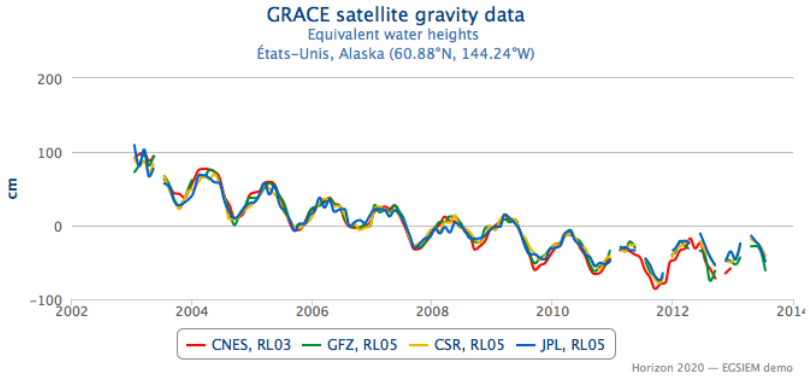
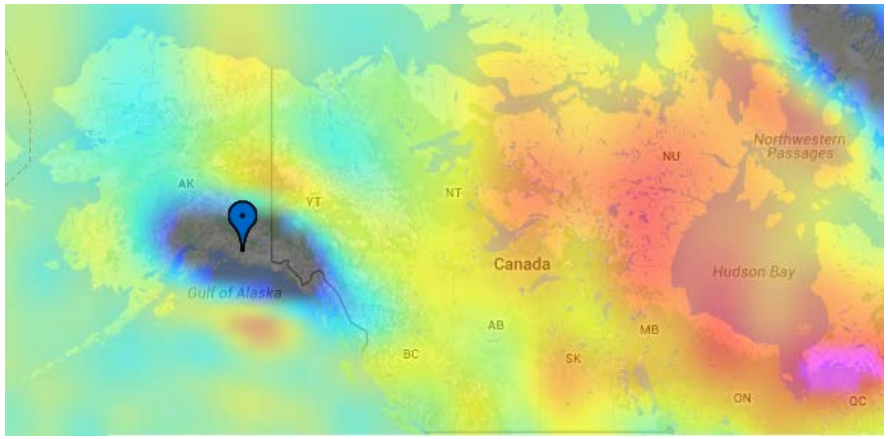
EGSIEM Visualization Tool: Interactive, fast and user-friendly visualization of results for scientific evaluation.









Summary and Outlook

- EGSIEM will run for three years (2015–2017)
- Three different services shall be established:
  - a scientific combination service
  - a near real-time (NRT) / regional service
  - a hydrological/early warning service
- Future integration into the services of the International Association of Geodesy (IAG), e.g., under the umbrella of the International Gravity Field Service (IGFS), and into the Copernicus emergency service is envisaged
- EGSIEM will have an open data policy and is open for collaborations with further partners.

Outlook

Collaborations/associated projects with other partners are very welcome. Service Level Agreements can be signed anytime during project duration.

Thanks a lot for your attention!